



Tevatron Stretcher: 120 GeV Fixed Target

Mike Syphers, Fermilab

21 August 2009

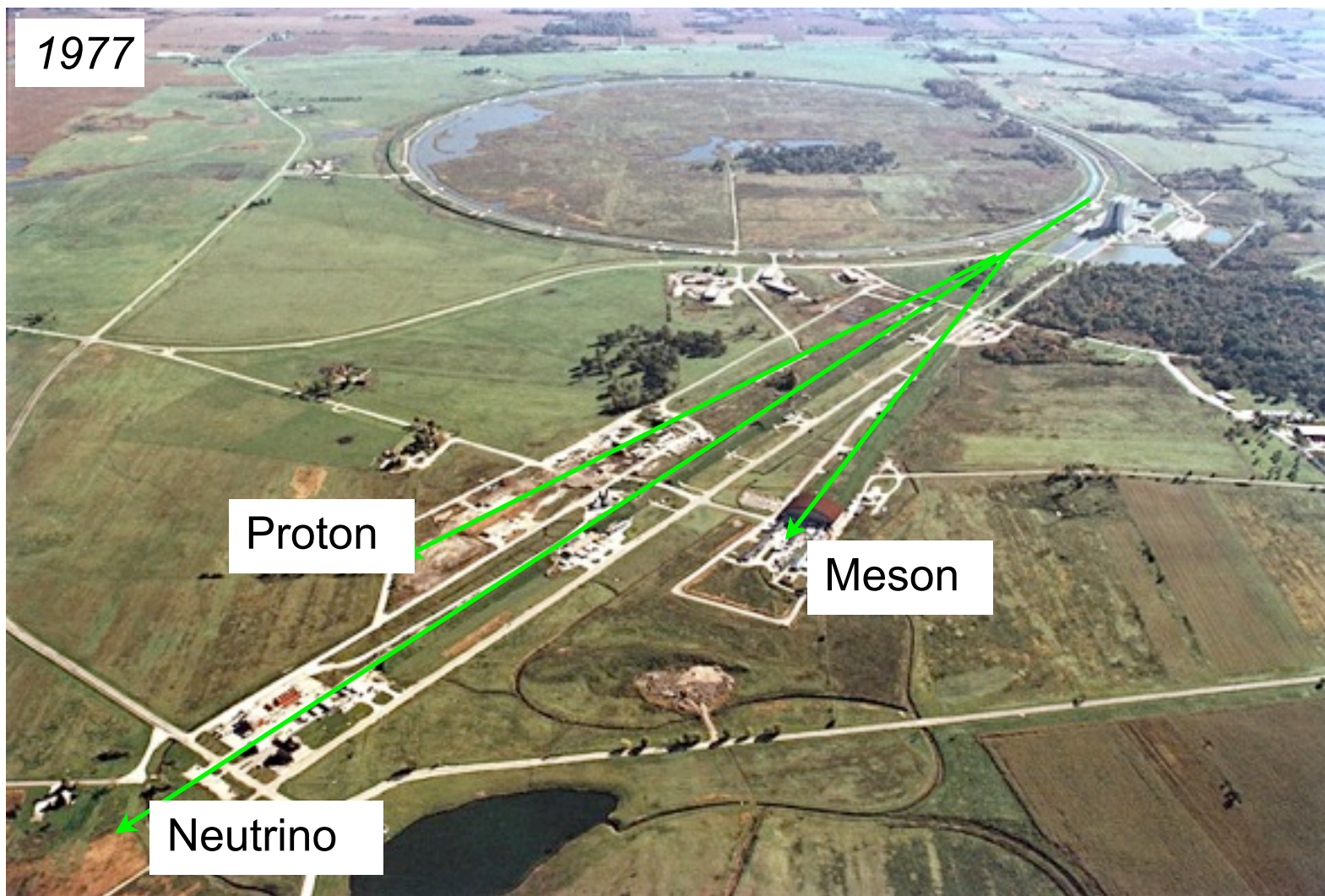
- *Short history of Fermilab Fixed Target*
- *Present & Future Operation of the Complex*
- *Tev120 Stretcher Option for post Run II*
- *Reconfiguring the Tevatron*
- *Issues and Remarks*



Fixed Target History



- ❖ Main Ring ran fixed target program until 1982
- ❖ Tevatron ran FT 1983-1996
 - shared time as Collider, ~50/50
 - also, short run in 2000





Fixed Target History



30 Tp in
1981

❖ Main Ring:

- 200-400 GeV
- 10-20 sec cycle
- $> \sim 3 \times 10^{13}$ ppp
(30 Tp)

❖ Tevatron:

- 400-800 GeV
- 40-120 sec cycle
- 20-28 Tp

❖ Resonant Extraction:

- slow spill
- pings



Fermi National Accelerator Laboratory

Operated by Universities Research Association Inc.
Under Contract with the United States Department of Energy

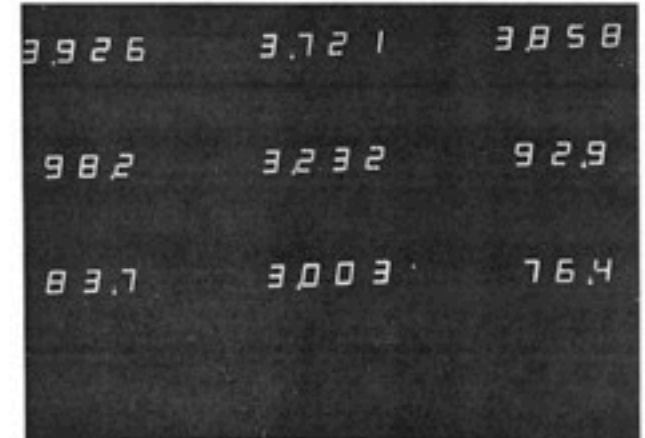
Vol. 4, No. 12

March 19, 1981

3.003×10^{13} PROTONS PER PULSE AT 4:25 p.m. ON SUNDAY, MARCH 15



Robert R. Wilson (center, foreground), Fermilab director emeritus, and Leon Lederman (right, foreground) join the celebration in the Main Control Room



The bottom, center number tells the story in four digits of the magnificent accomplishment. This Polaroid shot was taken in the Control Room and shows the panel that displayed the readouts from beam intensity monitors.

SPECIAL BULLETIN

The Accelerator Division set an all-time world intensity record of 3.003×10^{13} protons per pulse at 400 GeV at 4:25 p.m. on March 15.

ACCELERATOR DIVISION REJOICES

Throughout the Accelerator Division, signs proclaimed the division's recent



August 2009 Syphers 3

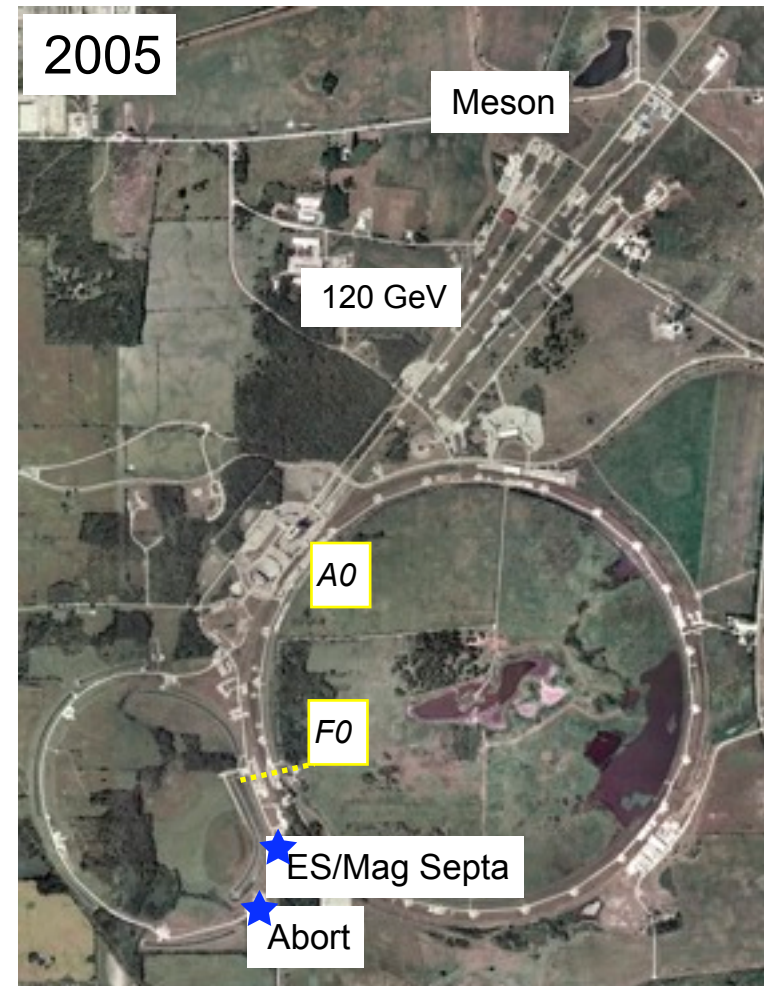
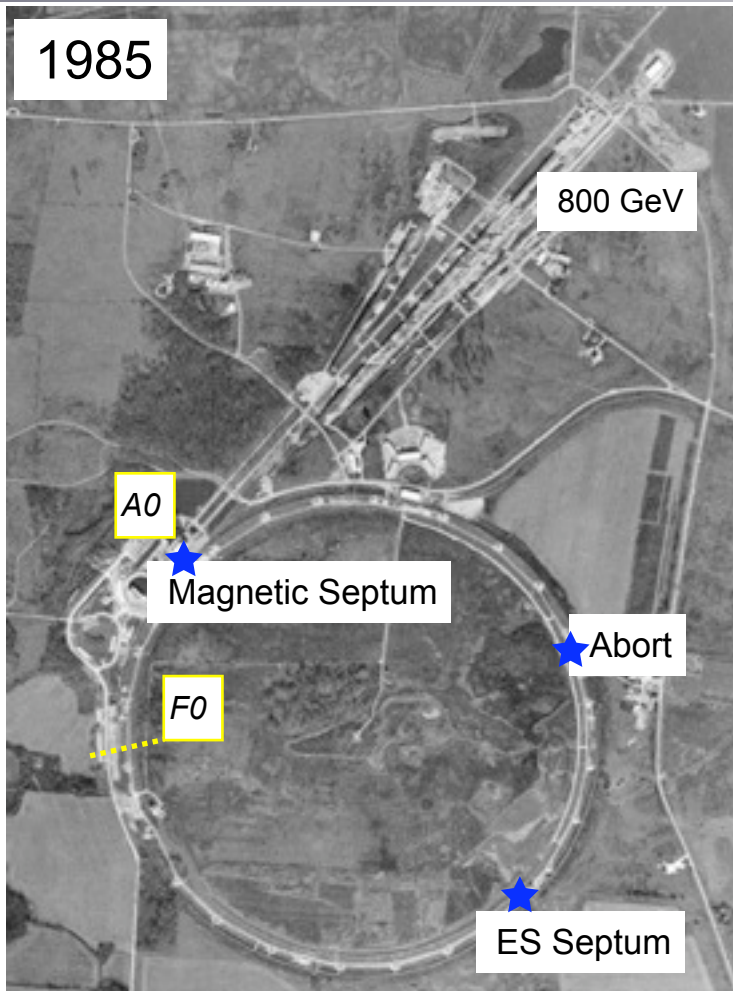


Enter Main Injector...

- ❖ With the commissioning of the Main Injector in 1999-2000, a “final” Tevatron FT run was performed. Fixed target physics was then relegated to a new 120 GeV program from the new synchrotron.
- ❖ This program, dubbed Switchyard 120 (SY120), began operation in 2004.
- ❖ The “F0” straight section is the switch point
 - beam from MI to Tev is injected at F0
 - beam from MI to antiproton source passes through F0
 - then, through Tev tunnel to F17 location, and out to pbar
 - beam from MI to SY120 passes through F0
 - then, through Tev tunnel to A0, and out to Switchyard



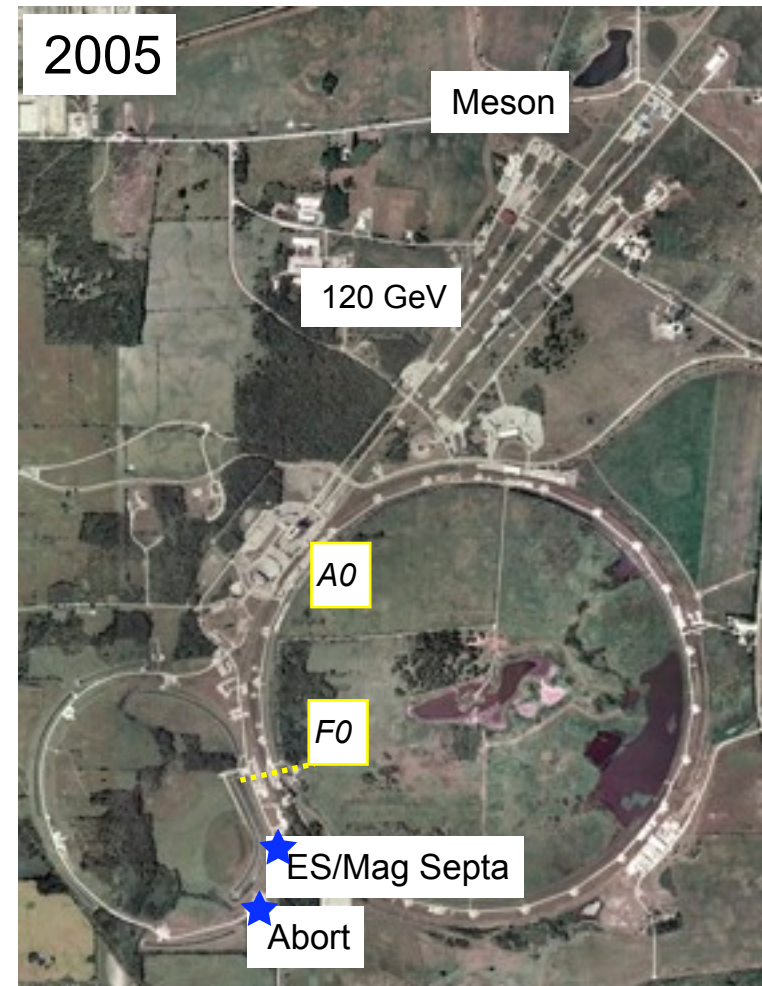
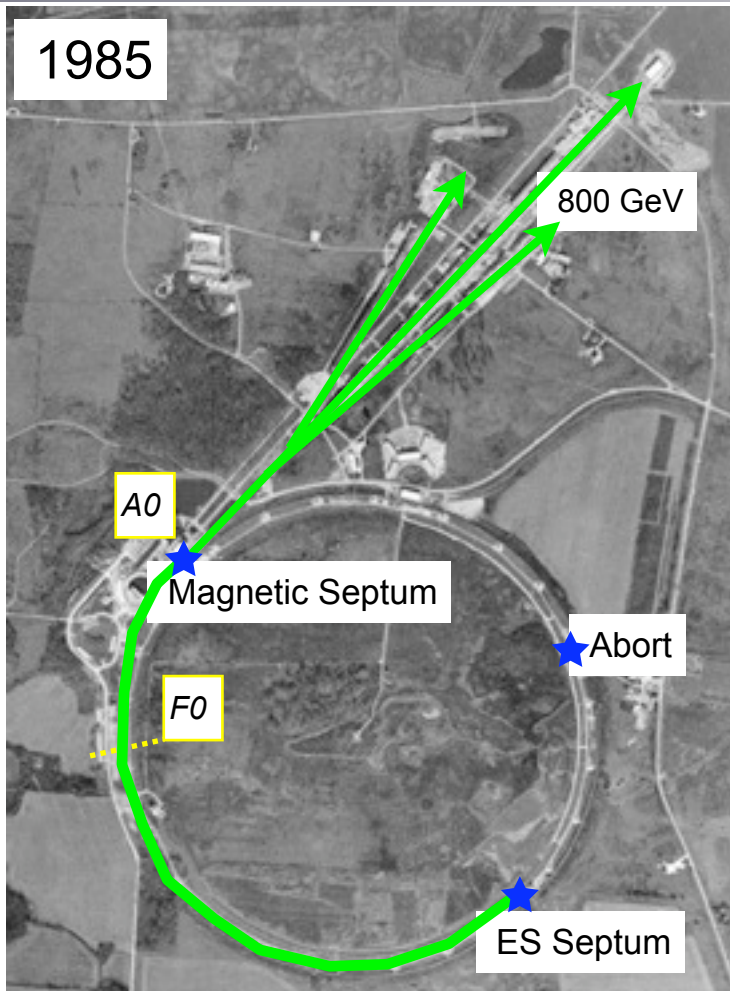
pre-MI and post-MI FT Configurations



- MR/Tev: beam extracted from A0 straight section
 - MI: transport to F0, thru MR remnant, to A0 and out...



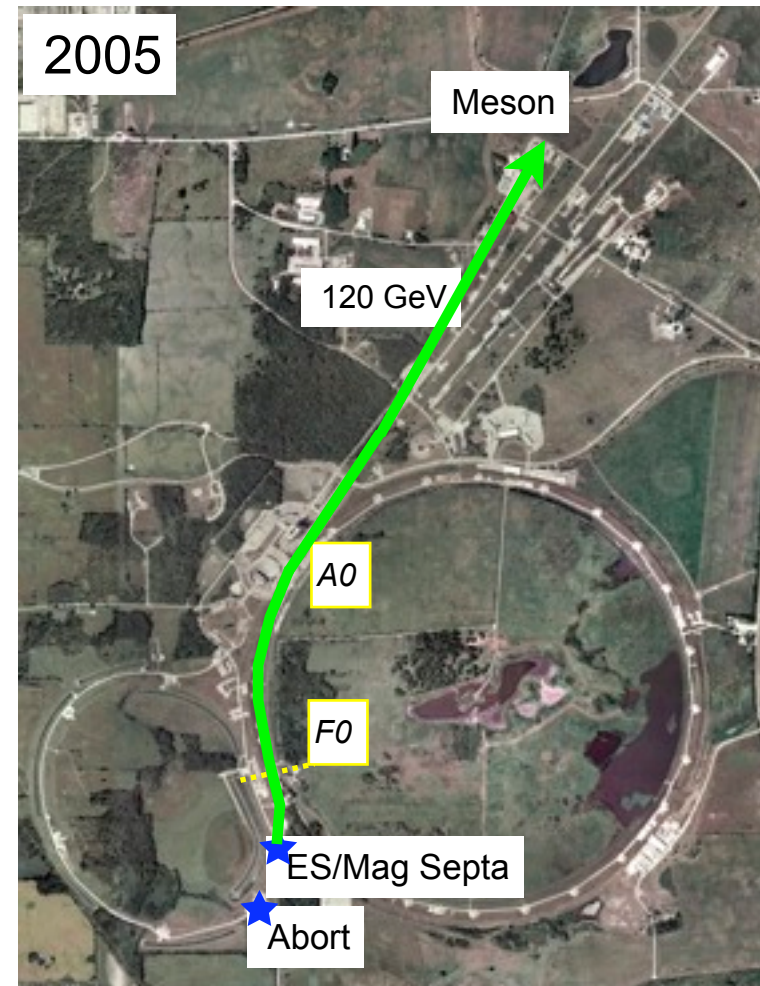
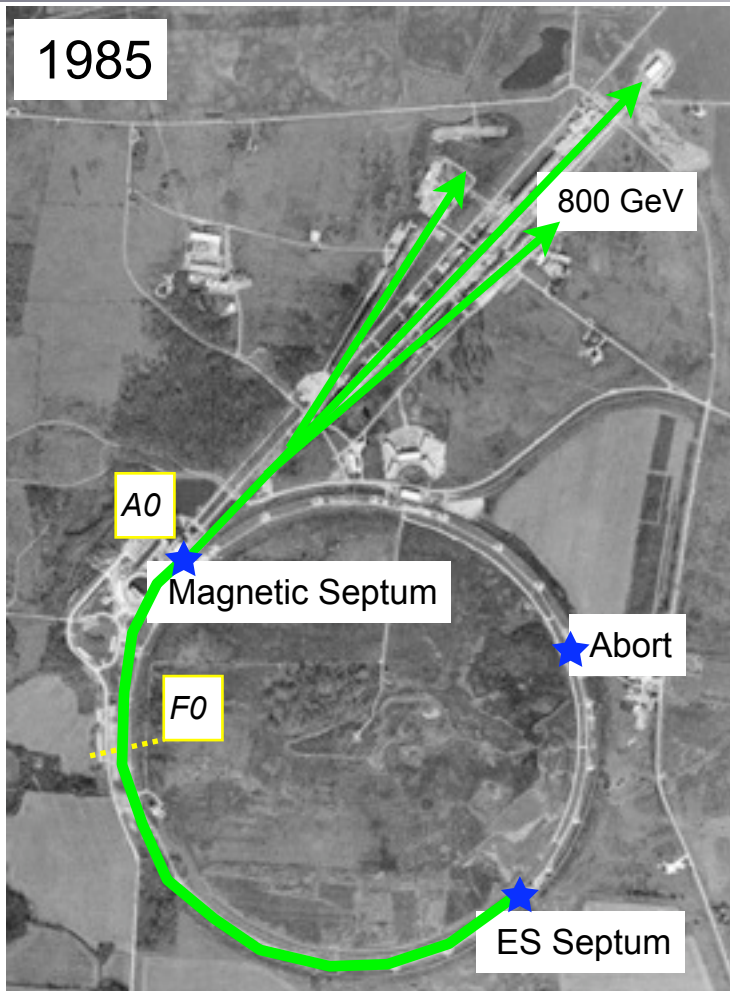
pre-MI and post-MI FT Configurations



- MR/Tev: beam extracted from A0 straight section
 - MI: transport to F0, thru MR remnant, to A0 and out...



pre-MI and post-MI FT Configurations

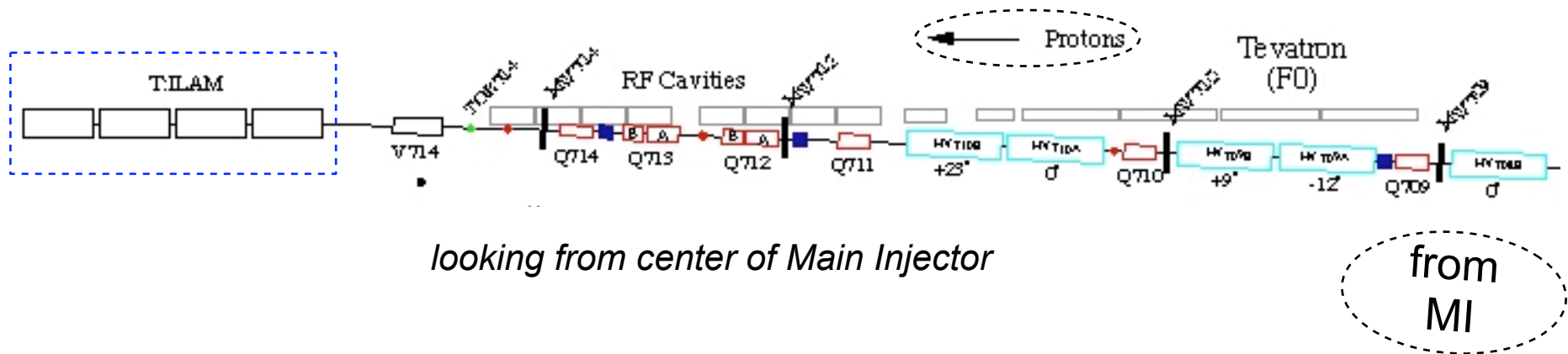


- MR/Tev: beam extracted from A0 straight section
 - MI: transport to F0, thru MR remnant, to A0 and out...



F0 Straight Section w/ Main Injector

- ❖ The Main Injector ties into the Tevatron tunnel at F0, where Tevatron RF cavities are also located



Beam approaches injection magnetic septa from below; if septa are on, beam is deflected vertically and eventually kicked onto the Tevatron closed orbit; if septa are off, beam passes through and on toward either pbar source or to the SY120 beam line



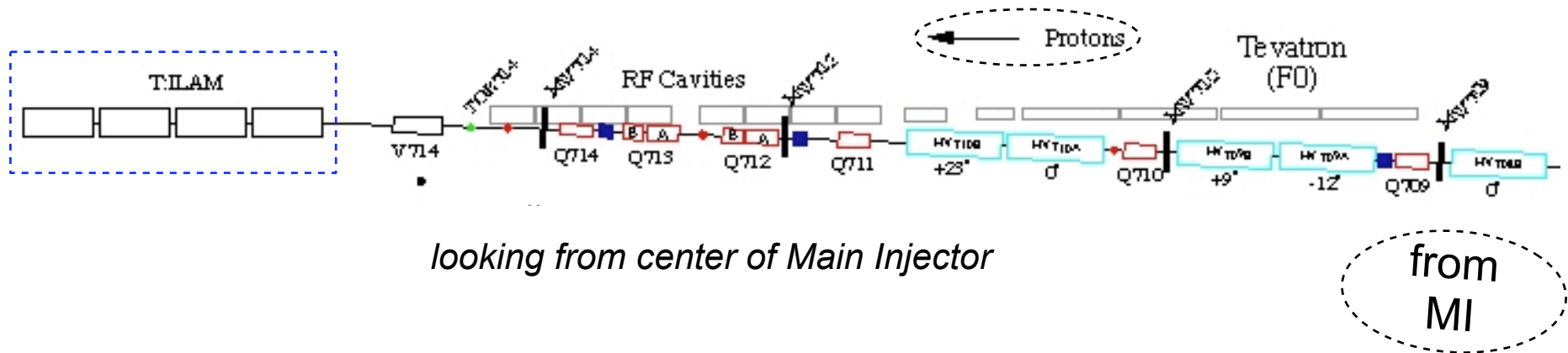
F0 Straight Section w/ Main Injector

- ❖ The Main Injector ties into the Tevatron tunnel at F0, where Tevatron RF cavities are also located

Lambertson Magnet:

if ON, then stays in Tevatron

if OFF, then to pbar/Switchyard



Beam approaches injection magnetic septa from below; if septa are on, beam is deflected vertically and eventually kicked onto the Tevatron closed orbit; if septa are off, beam passes through and on toward either pbar source or to the SY120 beam line



Main Ring “Remnant”

F0 Region:

Remaining Main Ring elements are used
to transport beam through Tevatron:

Final Destinations:

F17 --> pbar production

A0 --> to Switchyard

Protons to SY/pbar

Tevatron

Antiproton Injection



August 2009

Syphers

7



Switchyard 120

- ❖ “Main Ring Remnant” is used to transport beam from F0 to F17 (for pbar production) and/or on toward A0 and the Switchyard/Meson Test Facility.
- ❖ SY120 beam line runs at 120 GeV; with Power Supply upgrades could probably reach 150 GeV.
- ❖ Typical Operation:
 - When running, typically pulse one 120 GeV ramp approximately every 2 mins.
 - $\sim 1 \times 10^{12}$ (1 Tp) spilled (slow resonant extraction) over a 4 sec flat-top
 - i.e., 250 Gp/s (peak), 8 Gp/s (ave), 3.3% d.f.



List of SY120 Users since MI

List of Test Beam Memoranda of Understanding (MOU):

T988: AIRFLY - Air fluorescence, Under review
T987: DARK MATTER IN CCD's, Under review (MINOS tunnel)
T984: PHENIX VTX, Taking data
T979: Ultra-fast timing, Taking data
T978: CALICE Experiment, Taking data
T977: MINERvA Experiment, Under review
T976: CsI Timing Experiment, Experiment completed
T972: Radiation Shielding Experiment, Taking data
T971: LHCb Silicon Detector Upgrade, Taking data
T970: DHCAL Detector Research, Experiment completed
T969: GammeV, Experiment completed
T968: T2K Muon Monitor Prototype completed
T967: Muon g-2 Calorimeter Test, Experiment completed
T966: Monolithic pixel detector for ILC, Taking data
T965: PSiP Photosensors, Experiment completed
T964: ILC GEM Chamber Characteristics, completed
T963: STAR Muon Telescope Detector, completed
T962: Mini Liquid Argon TPC, Approved (MINOS hall)
T959: Microparticle Shielding Assessment, completed
T958: FP420 Fast Timing Test, Experiment completed

T957: NIU Tail Catcher/Muon Test, Experiment completed
T956: ILC Muon Detector Tests, Experiment completed
T955: RPC Detector Tests, Experiment completed
T953: U. Iowa Cerenkov Light Tests, Taking data
T951: ALICE EMCAL Prototype Test, Experiment completed
T950: Vacuum Straw Tracker, Experiment completed
T945-Add. 1: Muon Veto Detector for COUPP, Taking data
T945: COUPP Bubble Chamber, Taking data (MINOS hall)
T943: U. Hawaii Monolithic Active Pixel Det., Experiment completed
T941: UIowa PPAC Test, Experiment completed
T936: US/CMS Forward Pixel, Experiment completed
T935: BTeV RICH, Experiment completed
T933: BTeV ECAL, Experiment completed
T932: Diamond Detector, Approved
T931: BTeV Muon, Experiment completed
T930: BTeV Straw, Experiment completed
T927: BTeV Pixel, Experiment completed
T926: RICE, Experiment completed

see... <http://www-ppd.fnal.gov/MTBF-w/>



Proton Availability

❖ Present Daily Operation

- Set up p-pbar store in Tevatron, ...
- Produce more antiprotons, and drive the neutrino program
 - time line governed by 15 Hz Booster operation
- 7 Booster pulses to MI every 2.2 s
 - 5 for NuMI
 - 2 for pbar production
- Off-load pbars to Recycler ~every hour
- Spare Booster pulses to miniBooNE
- 1 pulse to SY120 occasionally...





Proton Availability

❖ Present Daily Operation

- Set up p-pbar store in Tevatron, ...
- Produce more antiprotons, and drive the neutrino program
 - time line governed by 15 Hz Booster operation
- 7 Booster pulses to MI every 2.2 s
 - 5 for NuMI
 - 2 for pbar production
- Off-load pbars to Recycler ~every hour
- Spare Booster pulses to miniBooNE
- 1 pulse to SY120 occasionally...





Proton Availability

❖ Present Daily Operation

- Set up p-pbar store in Tevatron, ...
- Produce more antiprotons, and drive the neutrino program
 - time line governed by 15 Hz Booster operation
- 7 Booster pulses to MI every 2.2 s
 - 5 for NuMI
 - 2 for pbar production
- Off-load pbars to Recycler ~every hour
- Spare Booster pulses to miniBooNE
- 1 pulse to SY120 occasionally...





Proton Availability

❖ Present Daily Operation

- Set up p-pbar store in Tevatron, ...
- Produce more antiprotons, and drive the neutrino program
 - time line governed by 15 Hz Booster operation
- 7 Booster pulses to MI every 2.2 s
 - 5 for NuMI
 - 2 for pbar production
- Off-load pbars to Recycler ~every hour
- Spare Booster pulses to miniBooNE
- 1 pulse to SY120 occasionally...

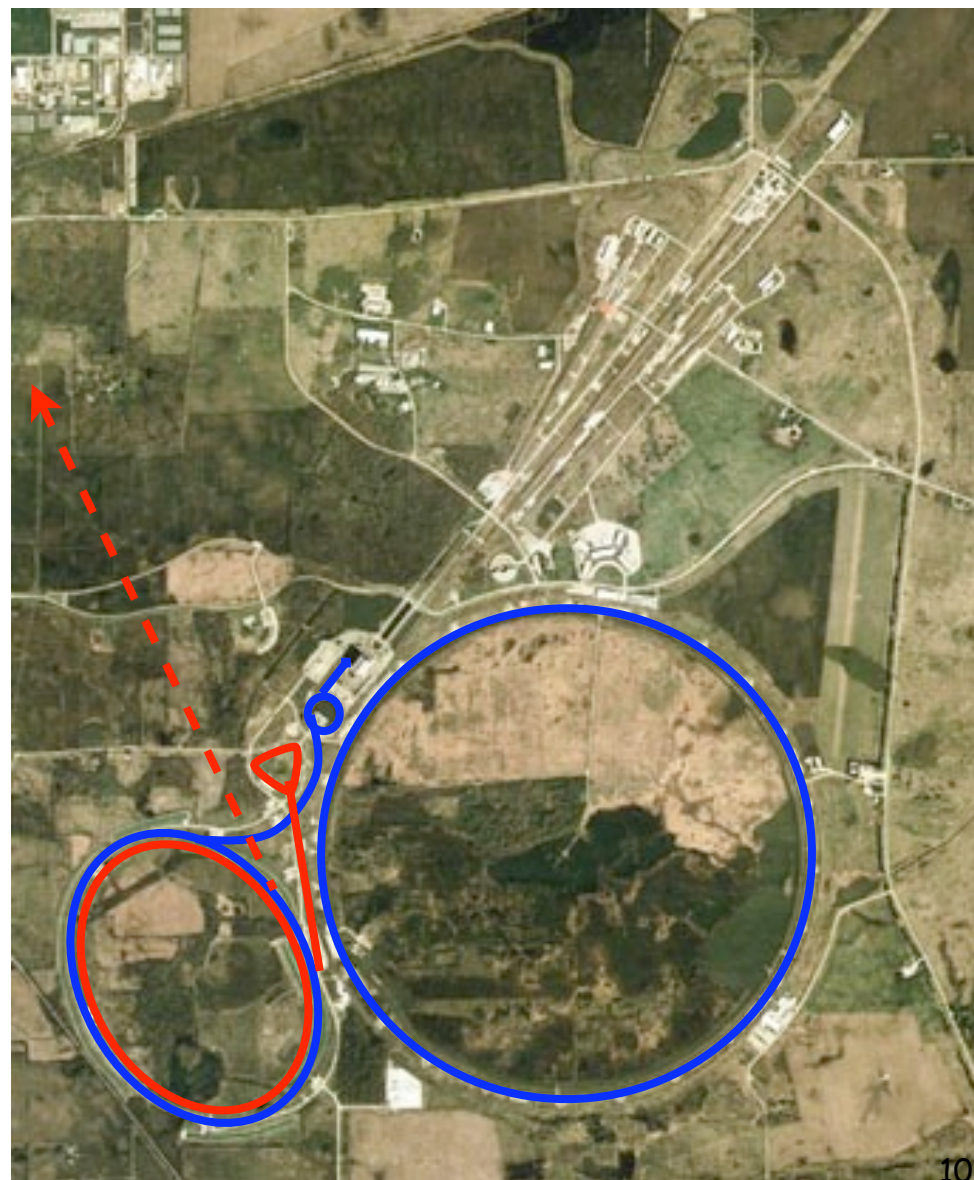




Proton Availability

❖ Present Daily Operation

- Set up p-pbar store in Tevatron, ...
- Produce more antiprotons, and drive the neutrino program
 - time line governed by 15 Hz Booster operation
- 7 Booster pulses to MI every 2.2 s
 - 5 for NuMI
 - 2 for pbar production
- Off-load pbars to Recycler ~every hour
- Spare Booster pulses to miniBooNE
- 1 pulse to SY120 occasionally...

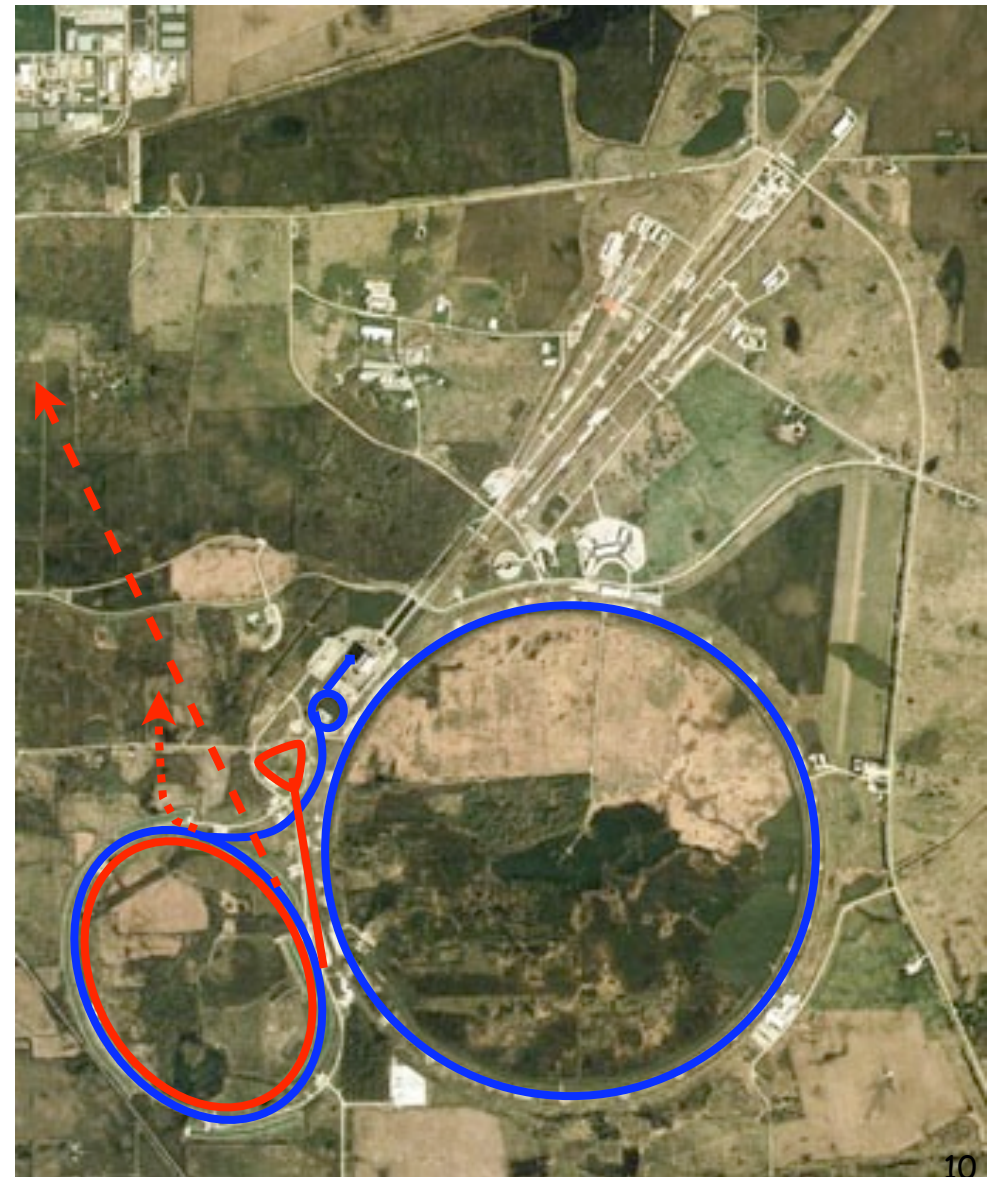




Proton Availability

❖ Present Daily Operation

- Set up p-pbar store in Tevatron, ...
- Produce more antiprotons, and drive the neutrino program
 - time line governed by 15 Hz Booster operation
- 7 Booster pulses to MI every 2.2 s
 - 5 for NuMI
 - 2 for pbar production
- Off-load pbars to Recycler ~every hour
- Spare Booster pulses to miniBooNE
- 1 pulse to SY120 occasionally...

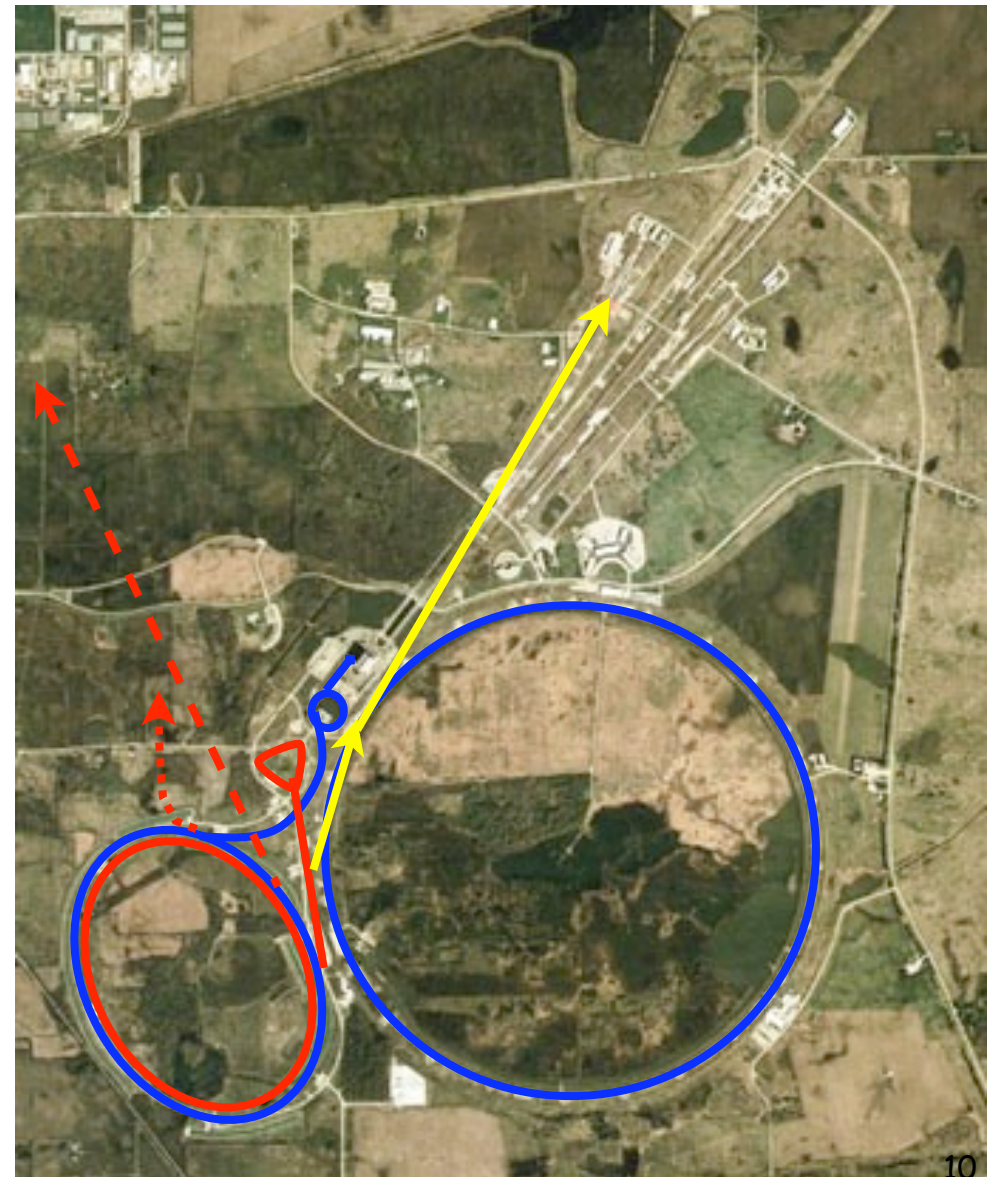




Proton Availability

❖ Present Daily Operation

- Set up p-pbar store in Tevatron, ...
- Produce more antiprotons, and drive the neutrino program
 - time line governed by 15 Hz Booster operation
- 7 Booster pulses to MI every 2.2 s
 - 5 for NuMI
 - 2 for pbar production
- Off-load pbars to Recycler ~every hour
- Spare Booster pulses to miniBooNE
- 1 pulse to SY120 occasionally...



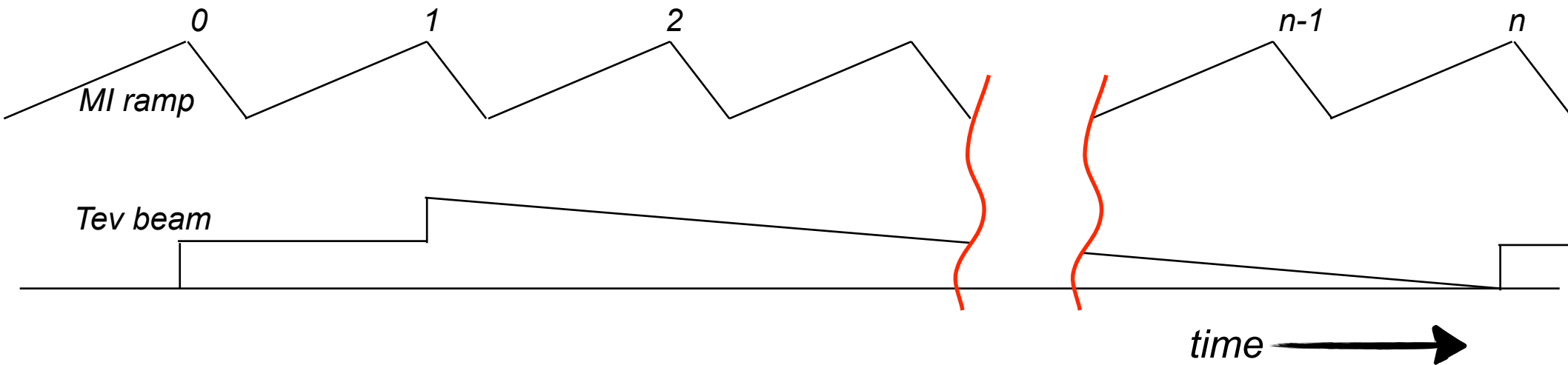


NOvA Era

- ❖ The NOvA project includes upgrades to the Main Injector and Recycler
 - following Run II, can use the Recycler to accumulate charge from the Booster as the Main Injector is ramping
 - allows for shorter cycle time, higher charge density
- ❖ Goal: 1.333 s cycle time for Main Injector
 - = 20/15 s, or 20 Booster pulses
 - uses Recycler to hold protons prior to MI injection
 - slip stacking --> 12 Booster pulse max. into Recycler
- ❖ Booster delivers $>4 \times 10^{12}$ (4 Tp) per cycle
- ❖ Can use SY120 more or less “as is” for a Fixed Target program with beam delivered from MI or Tev



Using the Tevatron



- ❖ **Tev circumference = $2 \times \text{MI}$**
 - take two MI cycles to fill
- ❖ **Use 2 cycles out of n , $n > 1$, for use in Tev120, the other $n-2$ used for N0vA**
- ❖ **slow spill during the available $n-1$ MI cycles**



“Historical” FT Intensity

Max Tevatron intensity = 30 $T_p = 3e13$ at 120 GeV

n	T[s]	df[%]	hit[%]	P _{ave} [kW]	P _{max} [kW]	<Ndot>[T_p/s]	Ndot _{Max} [T_p/s]
2	2.667	50	100	216	432	11.2	22.5
3	4.000	67	67	144	216	7.5	11.2
4	5.333	75	50	108	144	5.6	7.5
5	6.667	80	40	86	108	4.5	5.6
10	13.333	90	20	43	48	2.2	2.5
20	26.667	95	10	22	23	1.1	1.2
50	66.667	98	4	9	9	0.5	0.5
100	133.333	99	2	4	4	0.2	0.2
200	266.667	100	1	2	2	0.1	0.1



6 Batch Operation

Max Tevatron intensity = 48 $T_p = 4.8e13$ at 120 GeV

n	T[s]	df[%]	hit[%]	P _{ave} [kW]	P _{max} [kW]	<Ndot>[T_p /s]	Ndot _{Max} [T_p /s]
2	2.667	50	100	346	691	18.0	36.0
3	4.000	67	67	230	346	12.0	18.0
4	5.333	75	50	173	230	9.0	12.0
5	6.667	80	40	138	173	7.2	9.0
10	13.333	90	20	69	77	3.6	4.0
20	26.667	95	10	35	36	1.8	1.9
50	66.667	98	4	14	14	0.7	0.7
100	133.333	99	2	7	7	0.4	0.4
200	266.667	100	1	3	3	0.2	0.2



12 Batch Operation (slip stacking)

Max Tevatron intensity = 96 $T_p = 9.6e13$ at 120 GeV

n	T[s]	df[%]	hit[%]	P_{ave} [kW]	P_{max} [kW]	$\langle Ndot \rangle$ [T_p/s]	$Ndot_{Max}$ [T_p/s]
2	2.667	50	100	691	1382	36.0	72.0
3	4.000	67	67	461	691	24.0	36.0
4	5.333	75	50	346	461	18.0	24.0
5	6.667	80	40	276	346	14.4	18.0
10	13.333	90	20	138	154	7.2	8.0
20	26.667	95	10	69	73	3.6	3.8
50	66.667	98	4	28	28	1.4	1.5
100	133.333	99	2	14	14	0.7	0.7
200	266.667	100	1	7	7	0.4	0.4



FT Historical Comparisons

($T_p = 10^{12}$ protons)

	protons / spill time	cycle time	$\langle P \rangle^*$	P_{inst}^*	
400 GeV MR	30 T_p / 2 s	10 s	190	950	kW
800 GeV Tev	30 T_p / 20 s	60 s	64	190	kW
120 GeV MI	1 T_p / 4 s	120 s	0.2	5	kW
120 GeV Tev	30 T_p / 1.333 s	2.667 s	220	440	kW
	50 T_p / 1.333 s	2.667 s	360	720	kW
	100 T_p / 1.333 s	2.667 s	720	1400	kW
24 GeV AGS	70 T_p / 2.8 s	5.1 s	52	96	kW
120 GeV Tev	70 T_p / 25.333 s	26.7 s	50	53	kW

ca. 1981

ca. 1993

ca. 2009

E-871
rare Kaon Decay

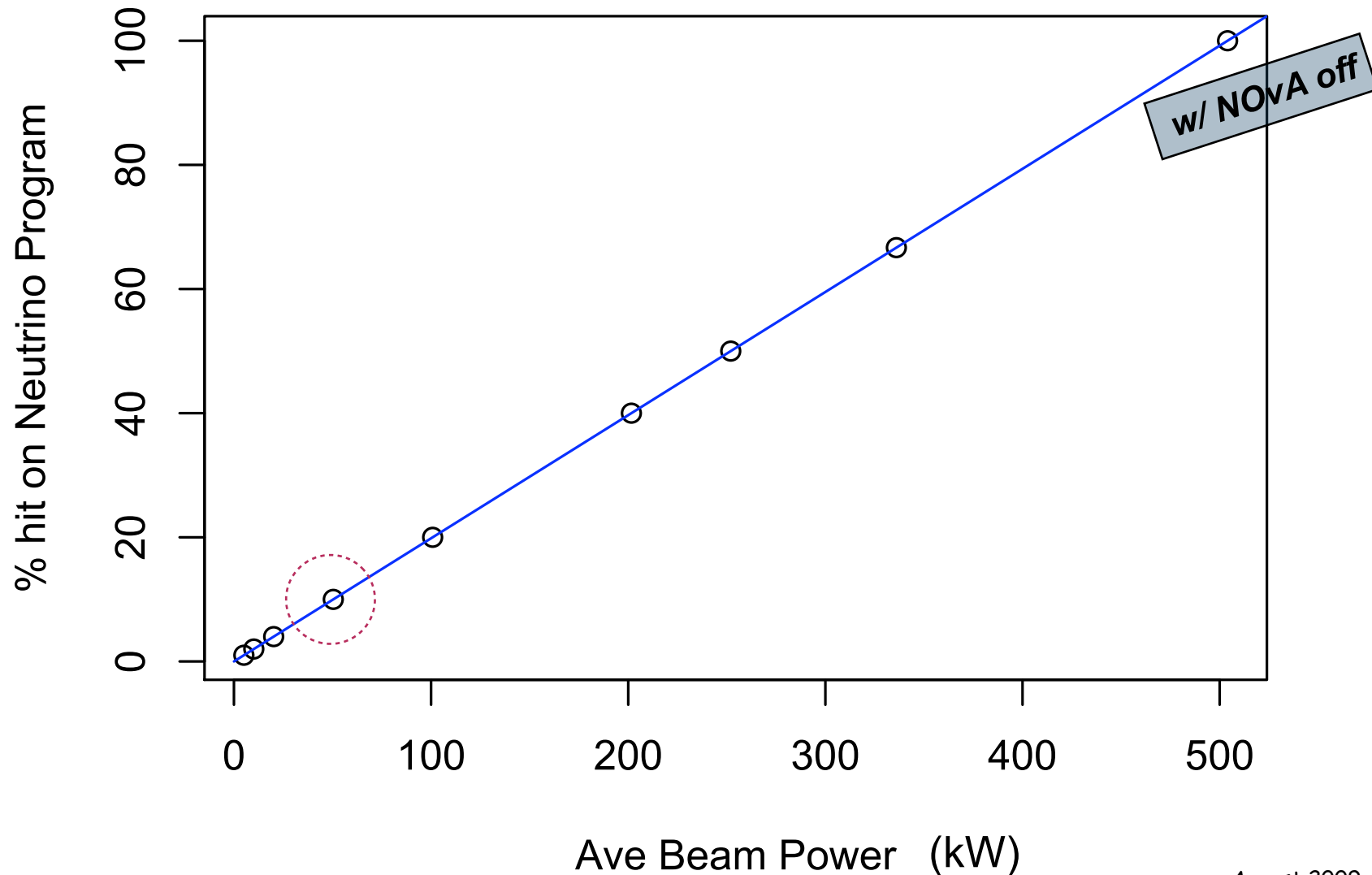
10% hit
on NOvA

*assumes all "slow spill"



Tev120 w/ NOvA

Assume 2 MI pulses to fill Tev, with 35 Tp each





TEV120

- ❖ Can use the F0 injection septum as an extraction septum (needs a polarity switch)
- ❖ Install electrostatic septum near F0, or perhaps C0
 - C0 presently “unused”; ideal for 1/2-integer extraction
- ❖ resurrect slow-spill feedback system (“QXR”)
 - fast air-core quadrupole magnets
 - may wish to upgrade electronics





TEV120

- ❖ Can use the F0 injection septum as an extraction septum (needs a polarity switch)
- ❖ Install electrostatic septum near F0, or perhaps C0
 - C0 presently “unused”; ideal for 1/2-integer extraction
- ❖ resurrect slow-spill feedback system (“QXR”)
 - fast air-core quadrupole magnets
 - may wish to upgrade electronics





Performance Issues at 120 GeV

❖ Intensity limitations

- Tevatron Fixed Target program ran at 20-28 Tp per pulse
- limited by intensity dependent instabilities at higher energy (typ. ~ 600 GeV) as momentum spread adiabatically reduced
- Transverse impedance of Tevatron improved during Run II
 - Lambertson Magnets identified as major sources, and beam tube liners introduced; greatly stabilized transverse motion

❖ However, ~ 30 Tp was also limit of the injector (MR)

- Today, the MI can deliver 40-45 Tp per pulse, and two pulses can be used to fill the Tevatron \rightarrow 80 Tp!
 - (same as AGS record intensities at Brookhaven, ~ 24 GeV)



Performance Issues

- ❖ Is there room (aperture) for extraction at 120?
 - beam at 120 GeV is 2.5 times larger than at 800 GeV
 - however, 120 GeV extraction has been made to work in MI with similar aperture constraints
 - Tevatron did extract at lower energies (400 GeV) upon commissioning (1983)
 - Emittance through injector chain much better controlled today than during previous Fixed Target times; though “blown up” during extraction process, more room for generating necessary step size across septa
 - would need further verification, but not at all unreasonable to assume 120 GeV extraction could be made to work in Tevatron



Tevatron Configurations

- ❖ pre-Y2K (2000, not Young-Kee...), would push/pull Fixed Target equipment with D0 detector, A0 abort
- ❖ C0 abort was proton-only; rated for high rate, high intensity fixed target operation.
- ❖ Would wish to reconfigure Tevatron back to pre-Collider configuration

	pre-MI FT	Run II Collider	
A0	Extr. Channel	Abort	<-- hi- β
B0	---	"CDF"	<-- low- β
C0	Abort	--- (BTeV)	
D0	ES septa	"D0"	<-- hi/low- β
E0	injection	instrumentation	
F0	RF	RF / injection	



Other Comments, Considerations

1. Can use existing A0 abort system in this scenario.
 - a. $100 \text{ Tp @ } 120 \text{ GeV} \sim 12 \text{ Tp @ } 1000 \text{ GeV} \quad \checkmark\checkmark$
2. Improvements made to impedances and to damper systems during Run II would help with possible beam intensity-related instabilities.
3. Consider using F0 Lambertson magnet for both injection and extraction -- needs polarity reversal switch. Could then use ESEP @ C0, or E48. Use existing SY120 beam line -- no need to re-establish A0 extraction area.
4. Beam is 2.5x larger at 120 GeV than at 800 GeV (for same emittance), so somewhat less aperture available for slow spill process.
5. Use barrier bucket scheme to contain beam during injection and slow spill -- no 53 MHz RF necessary (reserved for MI/NOvA)
6. Reconfigure to 1983 optics in long straight sections; better for extraction efficiency, and lower heat leak than in Collider configuration.
7. Re-establish QXR fast feedback system for slow spill.
8. Some estimates: $\sim \$8\text{M (ops)} + \sim \$7\text{M (labor)} = \sim \15M/year

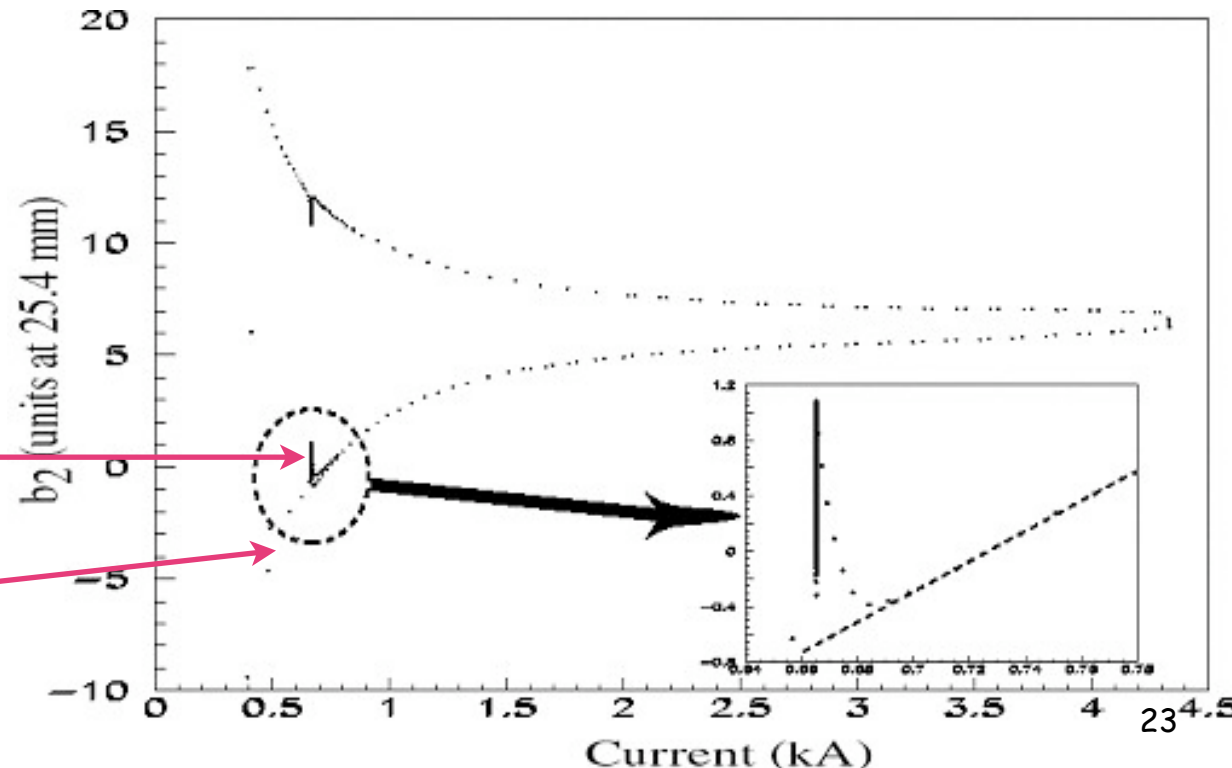


Other Comments, Considerations -- II

8. No magnet ramping, low-beta optics removed, and lower current (thus higher operating margin) --> more reliable operation of magnet system.
9. b_2 at 120 GeV \sim 25% worse than at 150 GeV, would affect chromaticity range, dynamic aperture, etc. However, b_2 drifts with time and would eventually reach asymptotic value (toward zero) -- not so bad?
10. Note: 8 GeV program not affected whatsoever;
Booster batches to fill
MI on SY120 cycles are
same as on NOvA cycles;
same spare Booster cycles
still available

30 min. drift at 660 A
(150 GeV condition)

120 GeV = 528 A





Outstanding Issues

❖ Beam Requirements

- What “beam” does a Kaon experiment require?
 - spill structure, energy spread, etc. -- determines RF system(s)

❖ Max Possible Tevatron Intensity at 120 GeV

- Need to verify what the Tevatron can hold
 - has not been tested since MI came on line

❖ Slow spill at 120 GeV

- Need to verify the aperture constraints/availability, slow spill process at this energy

❖ 120 GeV vs. 150 GeV

- Tevatron injection has always been 150 GeV; MI can pulse to this energy -- but perhaps not at 1.333 s cycle time (detail)
- Is possible, with small upgrades, to turn SY120 line into SY150



Schedule and Costs

❖ Implementation Costs

- re-install FT apparatus, convert B0/D0 to original optics
- upgrade F0 Lambertson to be able to switch polarity following injection
- re-implement QXR extraction equipment
- all needs detailed estimate, but essentially all parts exist; almost entirely labor costs

❖ Operating Costs (first pass, rough estimate)

- \$8M (ops) + \$7M (labor) = \$15M/year
- note: ~\$6M/yr to “keep cool” (LN2 temp)

❖ Time Line to Complete

- used to convert from FT:Collider (or vice versa) in ~1 month
- estimate ~3-6 mos. to perform conversion following Run II



Possible Pre-Project X Program

❖ Accelerator Operation becomes...

- Drive NOvA program with MI



- 1.333 s cycle time

(~650 kW)

- Fill Tevatron ~ every 1/2 minute



- ~95% duty factor to switchyard
- most to Kaon expt. (say), with occasional spill/split to MTest, ...

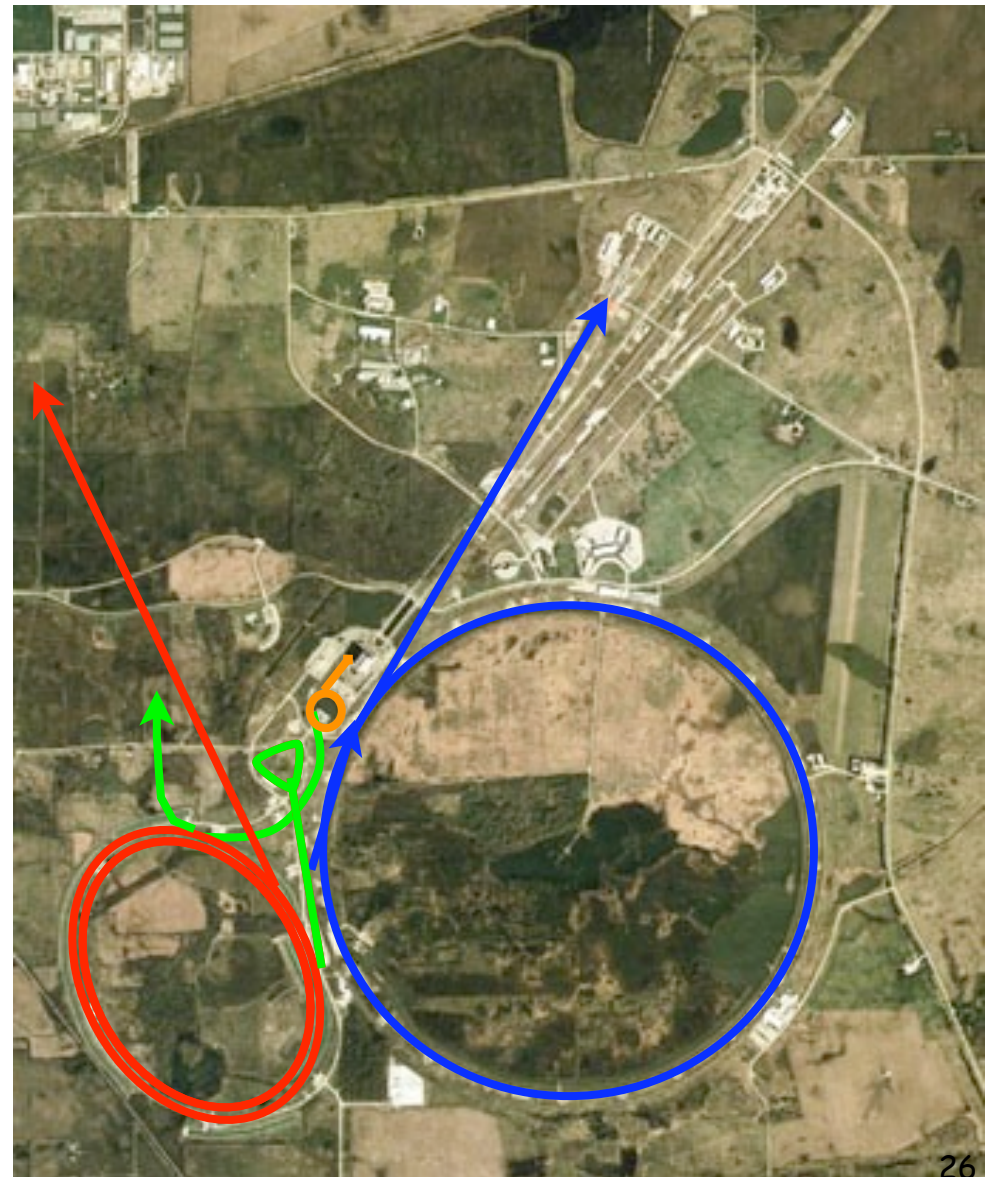
(~50 kW)

- Upgraded Booster system allows for



- concurrent hi rate 8.9 GeV/c program
 - mini/microBooNE, Mu2e
 - New g-2, MuCool, targeting R&D, ...
 - Kaons?

(~25 kW)





Summary (Accelerator)

- ❖ Stretcher -- “straightforward” to implement; fast turn-around time; SY120 program/beam line exists
 - higher intensities yet to be demonstrated, but process looks very feasible

- ❖ Need for further work: PAC Statement

The Committee reiterates its view that a high-statistics, on the order of 1000 events, $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ experiment represents very compelling science. While this was previously thought to be achievable only with the high power of Project X, the Committee was excited to hear about the prospects for such an experiment using the existing combination of the Main Injector and the Tevatron, operated as a stretcher ring, employing the well-studied techniques developed at Brookhaven National Laboratory where the initial observation of $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ was made. Such a high-priority experiment would considerably strengthen Fermilab's intensity frontier program in advance of Project X.

The Committee strongly recommends that Fermilab evaluate the cost and feasibility of various options for making the Tevatron available for the $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ and possibly other experiments. Should the Laboratory decide to proceed with this program, the Laboratory should ensure that the timeline is internationally competitive.

In light of the physics interest in rare-kaon experiments, it would be valuable for Fermilab to explore the full physics potential of the 120 GeV Main Injector and Tevatron stretcher opportunity as part of their Physics with a High Intensity Proton Source workshop series.

- ❖ Tevatron is unique facility for providing fixed target HEP beams
- ❖ Before dismantling the Tevatron and its infrastructure, should be sure that it truly has lived out its useful life
 - Tev120 -- quick set-up, high duty factor, make use of MI throughput
 - Tev800 -- would still remain as a future possibility



Summary (Accelerator)

- ❖ *The Committee reiterates its view that a high-statistics, on the order of 1000 events, $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ experiment represents very compelling science. While this was previously thought to be achievable only with the high power of Project X, the Committee was excited to hear about the prospects for such an experiment using the existing combination of the Main Injector and the Tevatron, operated as a stretcher ring, employing the well-studied techniques developed at Brookhaven National Laboratory where the initial observation of $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ was made. Such a high-priority experiment would considerably strengthen Fermilab's intensity frontier program in advance of Project X.*
 - ❖ *The Committee strongly recommends that Fermilab evaluate the cost and feasibility of various options for making the Tevatron available for the $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ and possibly other experiments. Should the Laboratory decide to proceed with this program, the Laboratory should ensure that the timeline is internationally competitive.*
 - ❖ *In light of the physics interest in rare-kaon experiments, it would be valuable for Fermilab to explore the full physics potential of the 120 GeV Main Injector and Tevatron stretcher opportunity as part of their Physics with a High Intensity Proton Source workshop series.*
- Tev120 -- quick set-up, high duty factor, make use of MI throughput
 - Tev800 -- would still remain as a future possibility



Summary (Accelerator)

- ❖ Stretcher -- “straightforward” to implement; fast turn-around time; SY120 program/beam line exists
 - higher intensities yet to be demonstrated, but process looks very feasible

- ❖ Need for further work: PAC Statement

The Committee reiterates its view that a high-statistics, on the order of 1000 events, $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ experiment represents very compelling science. While this was previously thought to be achievable only with the high power of Project X, the Committee was excited to hear about the prospects for such an experiment using the existing combination of the Main Injector and the Tevatron, operated as a stretcher ring, employing the well-studied techniques developed at Brookhaven National Laboratory where the initial observation of $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ was made. Such a high-priority experiment would considerably strengthen Fermilab's intensity frontier program in advance of Project X.

The Committee strongly recommends that Fermilab evaluate the cost and feasibility of various options for making the Tevatron available for the $K^+ \rightarrow \pi^+ \nu \bar{\nu}$ and possibly other experiments. Should the Laboratory decide to proceed with this program, the Laboratory should ensure that the timeline is internationally competitive.

In light of the physics interest in rare-kaon experiments, it would be valuable for Fermilab to explore the full physics potential of the 120 GeV Main Injector and Tevatron stretcher opportunity as part of their Physics with a High Intensity Proton Source workshop series.

- ❖ Tevatron is unique facility for providing fixed target HEP beams
- ❖ Before dismantling the Tevatron and its infrastructure, should be sure that it truly has lived out its useful life
 - Tev120 -- quick set-up, high duty factor, make use of MI throughput
 - Tev800 -- would still remain as a future possibility



Further Reading...

❖ Beams Documents Database:

- <http://beamdocs.fnal.gov/AD-public/DocDB/DocumentDatabase>
 - #2178 S. Nagaitsev, E. Prebys, M. Syphers, “First Report of the Proton Study Group”
 - #2222 M. Syphers, “Tevatron 120 -- Life after Run II?”
 - #2849 M. Syphers, “Discussion of Tevatron Fixed Target Options after Run II”

❖ Fermilab Steering Group Presentation (McGinnis):

- http://www.fnal.gov/directorate/Longrange/Steering_Public/meeting-2007-04-16.html



The "Competition"

❖ Some Projects and Proposals presently competing for resources at Fermilab:

Tevatron Collider Run II

NuMI/MINOS

NOvA

MINERvA

LBNE

LHC

SRF; ILCTA-NML

Project X

HINS / Neutrino Factory

Muon Collider / MuCool

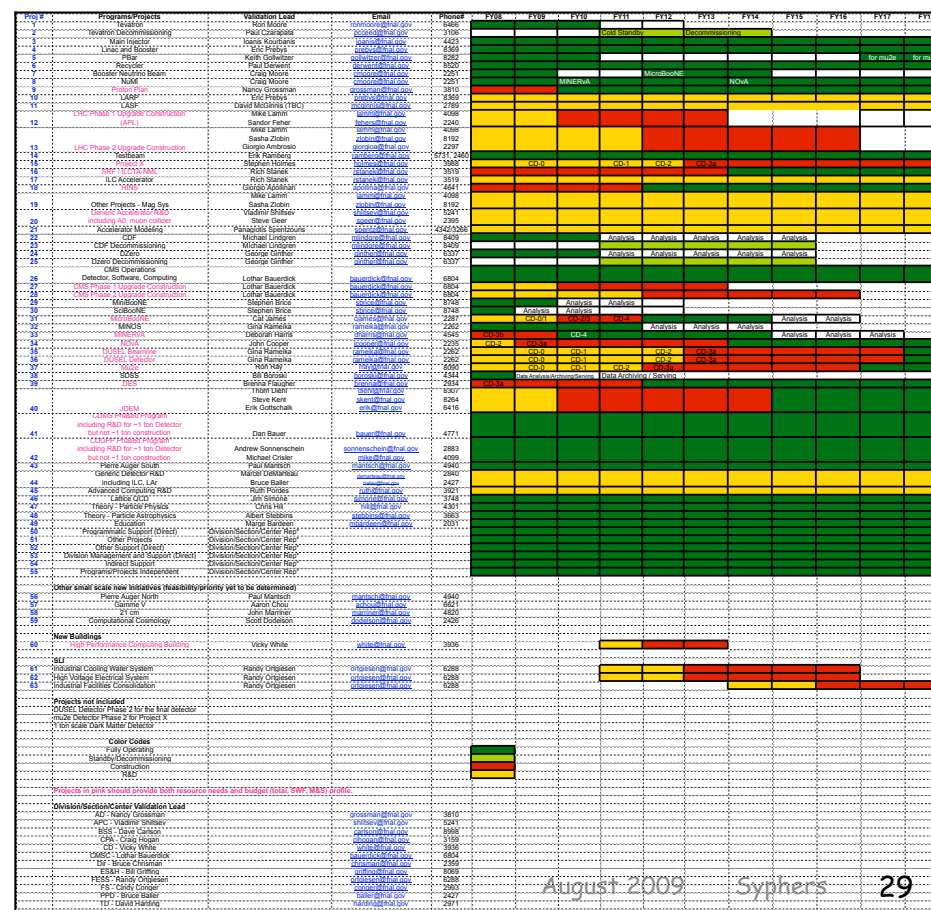
Proton Plan; microBooNE

DES; JDEM; CDMS

Mu2e

g-2 (not approved)

QHAP 10 Year Plan



August 2009

Syphers

29